

# CGMS-50 Working Groups (virtual)

## April-May 2022

### Key outcomes

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## 1. WORKING GROUP I

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1. WGI noted the status of discussion on frequency matters and preparations for the WRC-23. By the end of 2022, the SFCG rep will circulate the updated WMO preliminary position paper on WRC-23, after which CGMS members need to ensure the updated WMO positions are known to its members' national and international preparation processes for WRC-23.
2. The WGI Task Group on Satellite Data and Codes has been actively supporting the coordination of work on satellite product format issues within the CGMS community and providing support to the work of WMO's expert teams. As of 2022, the activities of the CGMS WGI ad hoc team on coordination of CF-netCDF conventions have been assimilated into the work of this Task Group.
3. WGI has taken the initial steps in forming a WGI Task Group on RFI detection, monitoring and mapping. CGMS agencies were invited to nominate additional members.
4. The WGI Task Group on Direct Broadcast Systems presented a well-received SWOT analysis on Low Latency Data Access from LEO meteorological satellites. The Task Group will perform further study on the possible usage of the identified emerging technologies. The WGI Task Group on the Coordination of LEO Orbits and the WGI Task Group on Direct Broadcast Systems will propose a consolidated direct broadcast and global data access SWOT analysis to CGMS-51.
5. The WGI Task Group on the Coordination of LEO Orbits presented draft Best Practices for the Coordination of Data Acquisition for Low Earth Orbit Satellite Systems. The CGMS agencies are invited to review the proposed Best Practices. The Task Group on the Coordination of LEO Orbits and Task Group on Direct Broadcast Systems will review the overlap between their best practices, and propose a way forward to CGMS-51.
6. The WGI Task Group on DCS presented a well-received SWOT analysis on the Data Collection Service from Geostationary meteorological satellites. Based on the SWOT analysis, the Task Group has put forward five proposals for further work, which it will continue to evaluate and develop in the lead up to CGMS-51.
7. The WGI Task Group on Space Debris and Collision Avoidance has been established. The Task Group will work on proposed Best Practices in performing collision avoidance and debris mitigation for recommendation in CMGS-51. All CGMS Members involved in spacecraft operations are strongly encouraged to nominate participants for this activity before CGMS-50 Plenary.
8. The HLPP was updated following review of WGI related matters. The revised HLPP will be presented to plenary for endorsement.
9. The WGI Co-chairs encouraged CGMS agencies to consider nominating additional members for all the WGI Task Groups by CGMS-50 Plenary, especially ones where no representatives of the agencies are currently participating in the Task Group(s).
10. Starting with CGMS-51, WGI agreed to adopt the approach of each of the Task Groups regularly presenting their latest Best Practices and status of Best Practices implementation, as well as

proposals for future activities taking into account the outcome of SWOT analyses. Each of the WGI Task Groups will also present its latest Terms of Reference to CGMS-51.

11. Vanessa Griffin from NOAA is retiring in May 2022 and will step down as the WGI Co-chair before CGMS-50 Plenary. The WGI participants thanked Vanessa for her valuable contributions and leadership as WGI Co-Chair. CGMS Agencies are invited to nominate candidates for Co-Chair of WGI. Sean Burns from EUMETSAT will step in as an interim WGI Co-chair, supporting until a new Co-Chair is nominated.
12. Karolina Nikolova from EUMETSAT was nominated as the Rapporteur of WGI for Plenary endorsement. CGMS Agencies are invited to nominate candidates for the Co-Rapporteur of WGI.

## 2. WORKING GROUP II

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1. The first civil meteorological satellite in early morning orbit FY-3E was launched on July 5, 2021. Instruments performance appears to be of high quality, and L2 products testing is in progress. There are three newly developed instruments onboard FY-3E (Wind Radar, Solar X-ray and Extreme Ultraviolet Imager, Solar Spectral Irradiance Monitor). The MERSI instrument was modified for the early morning orbit and includes a nighttime lights capability. FY-3E results were included in the GSICS State of the Observing System report.
2. WGII agreed to the GSICS EP recommendation to establish a subgroup within GSICS on Space weather Cal/Val and intercalibration. CGMS WGII members are encouraged to consider nominating people for this Subgroup, noting that the subgroup is preliminary set up for a 2-year period (Action WGIIA50.03).
3. WGII welcomed Dr. Joe Turk, JPL/Caltech, as a new IPWG Rapporteur, following the retirement of Ralph Ferraro/NOAA.
4. IROWG reaffirms that all providers of RO observations should classify these as essential in the sense of WMO Resolution 40 (see 16, in the new WMO data policy “essential” is replace with “core”) IROWG stresses the importance of free, timely and unrestricted access in real-time to essential (see above) RO data, and free and unrestricted access to archived raw data (including auxiliary data) (Rec WGIIA50.04).
5. ITWG to coordinate studies to assess the impacts of small satellite constellations including the upcoming NASA TROPICS mission.
6. IWWG to provide a summary overview of different methodologies to measure atmospheric winds (e.g., wind lidars, wind surface scatterometers, AMVs etc.) and with assessment of relative pros and cons so space agencies may use it as a guidance (best practice document) to make priorities in designing their instruments (Action WGIIA50.07).
7. IWWG has nominated Dr. Feng Lu (CMA) and Dr. Illana Genkova (NOAA/NWS) as new IWWG co-chairs. WGII requested and have received confirmation from their institutions supporting the nominations. Since nominations will be presented to plenary for endorsement, WGII consider having home institutions to confirm nominations as an important best practice.

8. The international Operational Satellite Oceanography symposia biennial series is intended to facilitate the efficient exploitation of satellite observations to substantially improve ocean and coastal environmental applications and decision-making. The Third International Operational Satellite Oceanography Symposium (OSOS-3) be held in South Korea to focus on Asia-Oceania needs. OSOS requests CGMS endorsement for the upcoming OSOS-3, planned for spring 2023 (Action WGIIA50.09).
9. Version 4 of the ECV inventory has been completed in the fall of 2021. The ECV gap analysis publication is expected to be completed by the end of 2022. Use cases for Climate Data Records is now a continuous activity of JWGClimate to demonstrate the value of the Climate Data Records for applications and decision making etc., but also in providing feedback towards quality improvements.
10. WGII noted with concern that AQUA, TERRA and AURA missions are being terminated impacting amongst others availability of polar AMVs, hyperspectral infrared (AIRS) and AURA MLS observations.
11. WGII supports in principal the proposal for the International Earth Surface Working Group (IESWG) as a new CGMS science working group and noted the strong request from the operational community, however would still need to review and approve updated Terms of Reference.
12. WMO held a GHG/Carbon Monitoring Workshop held on 10-12 May 2022 to provide international coordination of the effort; analogous to the WMO World Weather Watch and WMO's role in WIGOS, WIS, GDPFS - and to WCRP's role in AMIP, CMIP. There is community consensus on the need for a fully integrated, globally coordinated "Greenhouse Gas Watch" (TBC name), that encompasses Integrated observing system, ground-based and space-based assets; and Multi-center modeling and data assimilation systems (transport driven by NWP, including geospatially disaggregated sources and sinks terms).
13. EUMETSAT, together with NOAA and JMA, has started to address the CGMS plenary action to make better use of geostationary ring observations for climate. WGII recommends to eventually expand this activity to incorporate polar orbiting observations with the goal of creating a seamless global ring and to expand the coordination to other interested CGMS agencies.
14. WGII welcomed the presentation by CMA introducing the DQ-1 mission. It was noted that the DQ-1 LiDAR is a very interesting mission that potentially would be a good contribution to the overall global GHG and carbon monitoring systems providing also night-time observations.
15. WGII fully supports the NASA nomination of Dr Wenying Su as new Vice-Chair for JWGClimate.
16. The WMO Data Policy Resolutions Res 40 (weather), 25(hydrology) and 60 (climate) have in November 2021 been superseded with a new unified data policy (Res.1) for International Exchange of Earth System Data.
17. The HLPP was updated following review of WGII related matters. The revised HLPP will be presented to plenary for endorsement.

### 3. WORKING GROUP III

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1. The WGIII reviewed the results of the 2022 Risk Assessment Workshop held 22-24 February 2022, which included the 2022 Risk Assessment and updates to the CGMS Baseline Document.
2. The Risk Assessment showed an improved risk posture as a result of CMA's plans for FY-3J beyond FY-3E, to provide continuity in the early morning orbit for a microwave sounder, hyperspectral sounder, and multi-mission imager. FY-3J will also provide long-term continuity for short- and long-term radiometers.
3. FY-3I to provide continuity for precipitation radars beyond FY-3G.
4. The lack of geographically dispersed radio occultations; especially in the equatorial regions continues to be a risk.
5. Long-term plans for scatterometers are needed to ensure continuity.
6. There continues to be a risk of a gap for coronal imaging and plasma analysers at L1 until the SWFO-L1 mission is launched.
7. The WGIII reviewed updates to the CGMS Baseline Document, which included new space weather sensors to detect high energy electrons and protons as well as very high energy protons. The addition of new sensor types in the CGMS Baseline Document did not change the risk posture for space weather observations. Instruments hosted on commercial platforms were introduced into the CGMS Baseline for the first time.
8. The WGIII noted the status of WMO's efforts to establish core satellite data per the new WMO unified Data Policy. WMO will address the definition of core and recommended data with space agencies on a bilateral basis.
9. The WGIII reviewed the status of operational and research missions that impact the CGMS Baseline with new text proposed on hosted payloads and commercially sourced data and new space weather sensors to capture energetic particle measurements, as well as updates to reference documents.
10. WGIII noted the changes required to the Contingency Plan (e.g., references to documents needed to be updated; hosted instruments need to be accommodated; and experience from the first three Risk Assessments needed to be reflected in the Plan) and took an action to update it for CGMS-51.
11. WGIII reviewed its Terms of Reference and recommended an updated version to plenary for endorsement.
12. The HLPP was updated following review of WGIII related matters. The revised HLPP will be presented to plenary for endorsement.

## 4. WORKING GROUP IV

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1. In the framework of the WMO Regional Association (RA) II WIGOS Project to Develop Support for National Meteorological and Hydrological Services (NMHSs) in Satellite Data, Products, and Training, a Third Joint Meeting of RA II WIGOS PROJECT and RA V TT-SU for RA II and RA V NMHSs was held online, on November 5, 2021. The final report from the meeting was summarised, and WGIV took note.
2. The satellite broadcast services employed by CMA, JMA and NOAA continue to provide vital data access possibilities to a wide user community. CMA, JMA and KMA provided updates on their rapid scan imagery services for enhanced monitoring of hazardous weather and disaster risk reduction activities. The coverage of CMACast will be widened following a change of satellite platform resulting in coverage of a large part of Africa.
3. CMA, KMA and Roshydromet continue to evolve the range of satellite data provided for international exchange.
4. EUMETSAT and NOAA have both embarked on initiatives involving the procurement and redistribution of radio occultation data from the private sector. These data are being made available to the global NWP community via the GTS. NOAA and EUMETSAT are collaborating to ensure a consistent and non-redundant procurement approach. NOAA is also assessing the possibility of a similar concept for space weather data.
5. WMO has reworked its data categorisation approach and is now using the concepts of Core (shall be exchanged) and Recommended (should be exchanged). CGMS agencies will work with WMO to establish which satellite data and products are to be considered Core data.
6. Following a report on the initiation of the Earth Observation Training Education and Capacity Development (EOTEC DevNet), an opportunity is provided to connect to a new user community. Participation by WGIV members in an upcoming regional meeting continues to be encouraged.
7. In support of the Ocean Community, KMA started a new marine weather broadcast service by GK2A satellite in mid-2020. They provide high-quality digital marine weather information to ships operating at sea.
8. The VLab report and an overview of GeoXO's User Engagement Process emphasise that training and capacity building is a key element of preparing the user communities for new systems, long before a new missions become operational.
9. The Task Group on Cyber Security has not met since March 2021. The nature of the issues involved and the associated national practices limit the efficacy of multilateral collaboration. This raises the need for re-discussing the scope/purpose and modality of the group.
10. The Task Group on Metadata held an initial kick-off meeting in February, 2022. The Task Group on Satellite Data and Codes was moved to WGI. And WGIV continues to look for additional members for participation in the regular Task Group on User Readiness.

11. The Expert Group on Cloud Services interoperability has been very active for the past 2 years. The group hosted a Cloud Workshop in March 2022. Best practices, trends, and common themes were identified amongst workshop presentations, and will be incorporated into the group's document for presentation and endorsement at the CGMS-51 Plenary in 2023.
12. CEOS (Committee on Earth Observation Satellites) Working Group on Information Systems and Services (WGISS) shared their Best Practices for Space Data Preservation.
13. The HLPP was updated following review of WGIV related matters. The revised HLPP will be presented to plenary for endorsement.
14. Mrs. Natalia Donoho (NOAA) and Dr. Simon Elliott (EUMETSAT) were nominated as Co-Rapporteurs of WGIV for Plenary endorsement.

## 5. SWCG – SPACE WEATHER COORDINATION GROUP

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### 5.1 SWCG SESSION

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1. The updated CGMS Baseline aspects relevant to space weather were agreed, in particular:
  - a. Inclusion of hosted payloads where a commitment for continuity from a CGMS Member is made (e.g. ESA hosted payloads on commercial communications satellites).
  - b. Splitting of the baseline commitment for energetic particle sensors into different energy ranges (locations to be added prior to WGIII WG).
2. The CMA FY-3E LEO satellite continues with a space weather observation package including for the first time a Solar X-ray and Extreme Ultraviolet Imager. CGMS members are interested in data access for user applications and comparison purposes.
3. A broad range of ESA activities were presented including:
  - a. The ESA Lagrange 5 mission, renamed "Vigil", is on track for launch in 2028, subject to approval in 2022. It will embark a NOAA payload and a NASA payload is also under discussion. Some limited payload descopeing has taken place to reduce cost in coordination with the user representatives. ESA foresee this to be the first in a series of operational missions to L5.
  - b. Particle sensors are being embarked in LEO and GEO on EUMETSAT satellites as well as commercial satellites as hosted payloads.
  - c. A LEO constellation of 16 nanosatellites carrying particle sensors, magnetometers, radio beacons and ions and neutral spectrometers is under definition, with a potential launch in 2026.



- d. An auroral monitoring constellation is also under definition, with potential demonstration in 2027 and full deployment in 2030.
  - e. Further nanosat missions are under analysis following a community challenge initiative received proposals.
  - f. As part of the transition to operations activities of the European Space Weather Network, ESA are also working on enhancing the R2O O2R and modelling environments.
4. KMA has plans to continue and improve its space weather payload on GK2A Follow On satellite to be operational from 2029.
  5. NOAA are making good progress on the SWFO L1 mission, with launch planned for 2025. Contingency measures to mitigate a potential gap due to the current reliance on ageing spacecraft at L1 are limited. The ISRO Aditya L1 mission is not planned to support operational data latency requirements at the current time.
  6. NOAA/NESDIS Space Weather program is making good progress:
    - a. GOES-18 Operational
    - b. First Compact CORonagraph (CCOR) integrated on GOES-U
    - c. SWFO-L1 development on track for rideshare with NASA IMAP mission
    - d. Established agreement with ESA on data sharing, potential ground-station and
    - e. instrument cooperation
    - f. COSMIC-2 space weather products available and TEC latency objective met
    - g. NOAA establishing Space Weather Next Program to implement next generation
    - h. space weather observations
    - i. NOAA is planning to issue an RFP for commercial space weather data
  7. NASA presented the broad scope of their activities including:
    - a. The Heliophysics System Observatory, which together with partners comprises 20 operational spacecraft, 12 in formulation and 6 under study.
    - b. Efforts to facilitate the exchange of new observations, models and applications between research and operations activities.
    - c. Cubesat mission selections.
    - d. The Hermes space weather instrument package in support of Gateway, a vital component of NASA's Artemis program, has been confirmed for flight.
  8. NICT are continuing their operations as a member of ACFJ consortium, one of the ICAO's global center, and working on alert level definitions for spacecraft operations and the further development of the SECURES tool for real-time estimation of surface charging risk for GEO satellites.
  9. NOAA Space Weather Prediction Center highlighted that Solar Cycle 25 has had a very active start and discussed the interaction with Starlink following the loss of 39 satellites due to prolonged low-

level geomagnetic storm in early February 2022. SWPC are also fully engaged in the R2O O2R and modelling environment improvements, as well as providing ICAO support.

10. WMO reported activities based on the Four-year Plan for WMO's Coordination of Space Weather Activities 2020 - 2023 (FYP2020-23):
  - a. WMO will be cooperating with ISES and COSPAR to improve international coordination of Space Weather activities.
  - b. WMO has established an Expert Team on Space Weather (ET-SWx) with a broader mandate than the former IPT-SWeISS.
  - c. WMO is preparing the establishment of core satellite data for Space Weather following the new WMO Unified Policy for the International Exchange of Earth System Data (Res. 1).
11. ISES reported on their activities and noted a need for rationalisation between various groupings, an effort which WMO have also identified as a priority as reported above.
12. The identification of services for space surveillance and tracking users was discussed by ESA which also links to some of the efforts under study at NOAA SWPC.
13. Progress is made on ensuring the correct structuring of space weather data within the WMO OSCAR database, including the implementation of data latency information.
14. A white paper for the inter-calibration of energetic particle sensors in GEO has been submitted to GSICS, but further interaction is required to formulate operational framework. The GSICS Executive Panel decided to form a sub-group on space weather instrument inter-calibration at their Annual Meeting and the outcome will be made to the CGMS Plenary.
15. The HLPP was updated following review of SWCG related matters. The revised HLPP will be presented to plenary for endorsement.

## 5.2 WGI-WGIV-SWCG JOINT SESSION

1. The Space Weather Spacecraft Anomaly Database objective is to be the data source for space weather actors to analyse the impact of space weather on satellite systems, in order to improve tools modelling space weather effects, spacecraft design robustness and support the spacecraft operations community with space weather warnings and improved post-event anomaly analysis. The blocking issue concerning the lack of input data highlighted at CGMS-49 has continued to be problematic and it has been discussed whether or not it makes sense to continue with this effort at CGMS level. As a result, some potential courses of action relating to confidentiality concerns and workload have been identified which may help improve the situation, overcoming the perceived issues which are preventing the supply of data. Further engagement with the spacecraft operations community is also proposed through an updated survey (following the last one performed in 2018) and consideration of whether Best Practices in usage of space weather data for post-event anomaly analysis and risk mitigation based on forecasts can be formulated. A NICT Paper provided an analysis of anomalies on GEO satellites using event log of satellite observations, the results of which provide more confidence that a better definition of warning thresholds for spacecraft operator alerts should be achievable. It is therefore recommended to continue with

the TG effort with these actions and decide prior to CGMS-51 whether sufficient progress has been made to justify the continuation of this TG effort.

2. Progress has been made on improving the data latency of ionospheric RO data by COSMIC-2 and the SWCG has held an exploratory meeting with, IROWG and ROM SAF participants. It has been agreed to include the participants as members in the Ionospheric Radio Occultation System Optimisation Task Group. This will address the aspects of Data Latency, Number of ionospheric measurement counts for the whole system, Observational Simulation Experiments to address sensitivity of operational applications to changes in latency / counts for establishment of requirements, potential improvements in CGMS Member RO measurement capabilities and / or data access in support of such requirements.
3. The SWCG has undertaken a number of outreach activities with the operational space weather user community since 2018 in order to identify potential improvements which could be implemented by CGMS members to better service the user needs. This has included a number of surveys and dedicated discussion forums held in the context of annual space weather workshop events in Europe and the US. In order to help glue this feedback together and focus on the priorities, a Task Group is proposed with the objective of identifying and acting on the needs of the operational Space Weather Service community (referred to here as “Users”) including consideration of both in-orbit needs as well as improvements to data formats and ground segment dataflow. Due to the wide scope of aspects under consideration, the TG will firstly prioritise the main areas to address until CGMS-51 with the aim of providing some short-term returns as well as ensuring the basis for improvements in the longer-term. CGMS is invited to consider TG Draft Terms of Reference on Improving User Data Access to Space Weather Data from Orbital Sensors.
4. The international regulatory framework, the ITU Radio Regulations (RR), so far do not contain any recognition or provisions related to space weather observations using radio frequencies. The World Radiocommunications Conference 2023 (WRC-23) will now deal with space weather frequency related issues under agenda item 9.1 Topic A. This agenda item is actually twofold with preparatory studies, with no regulatory actions at WRC-23, followed by a WRC-27 agenda item with the aim to actually establish regulatory conditions in the Radio Regulations in support of space weather observations.